Most of what had been described in pages 1 – 6 of the application as filed consisted of "background" of the invention and was intended to show the thinking processes and investigations conducted by the inventors in arriving at their invention. This discussion was not intended to describe what is in the prior art, and it is Applicants' belief that this background information was generally not known outside of Furukawa Electric Co. Ltd., the assignee of the present application. In order to clarify the correct status of the information, Applicants have amended the Specification to consolidate the description of FIGS. 1-5 in one section of the application. **Claims 1-8 and new Claims 9-28 are pending.**

Applicants would like to thank the Examiner and her acting Supervisor, Examiner Quyen Leung, for the courtesy extended during the Interview held on February 12, 2002. In advance of the Interview, Applicants submitted proposed draft amendments to the Specification, proposed voluntary amendments to Claim 1, and a set of proposed new claims. The outstanding rejections, proposals for the Specification were discussed at the interview, and the proposed voluntary amendment to Claim 1 and the proposed new claims were briefly discussed. Supervisor Leung suggested that Applicants discuss MPEP §2129 and the court case of *In re Nomiya*, 509 F.2d 566, 184 USPQ 607, 610 (CCPA 1975) in the filed Amendment. The Examiner and her Supervisor indicated that an Amendment would be given careful consideration once it is filed. Because the substance of the Interview, and of the draft proposal considered at the interview are fully described and discussed in this Amendment, Applicants respectfully request that the draft proposal, which was presented solely for discussion purposes in order to expedite the interview, and which were never intended to be made part of the official file, be purged from the file.

<u>Response to the Allegation of Admission of Prior Art.</u>

With the rejection of Claim 1–8 under 35 U.S.C. §103(a), the Office Action is premised on the Examiner's belief that Applicants have made an admission that FIGS. 1 and 2 of the application and pages 1-6 of the Specification are prior art. Applicants submit that there is no admission that the discussion relied upon by the Examiner describes the prior art. Applicants submit that, as a matter of law, the Examiner cannot rely solely on location of the text at issue to find that there is an admission. Rather, any finding of admission must be based on the content

that the text itself, *e.g.*, an explicit statement that the subject matter being discussed is prior art. In fact, the text at issue is in the nature of a discussion of the background of the invention, and describes the Applicants' thinking processes and investigations which lead them to their invention. However, there is no reason for the Examiner to believe that the Applicants thought that what is described in this text was known in the prior art. In order to put the text in the proper context, the present amendment moves the discussion to the main body of the specification.

In a recent article in the Journal of the Patent and Trademark Office Society, PTO Administrative Law Judge Lance Leonard Barry observes that it "is not unusual for an applicant to juxtapose a description of the invention with a description of prior art" (JPTOS, Vol. 82, No. 5, May 2000, pages 347-365, at page 359). He goes on to further state on page 359 that an "Examiner should not assume that all descriptions in a Background of the Invention section of a specification or that all features in a figure labeled as prior art are admission of prior art," and that "the record as a whole" should be considered when deciding what is admitted prior art. In the case of *In re Nomiya*, 509 F.2d 566, 184 USPQ 607, (CCPA 1975), both the PTO Board of Patent Appeals and the Court of Customs and Patent Appeals (the predecessor of the CAFC) did not assume that everything stated in the Background of the Invention section was admitted prior art, and both looked to the content of the text and figures at issue to determine which pieces of subject matter therein were being admitted as prior art[1]. The patent application of Nomiya, *et al.*, was granted as U.S. Patent No. 4,044,373, with the text at issue appearing under the title "Description of the Prior Art," including those portions which were not found to be admitted prior art by the Board and the Court. As it relates to the issues at hand, MPEP §2129 only provides a brief review of the *In re Nomiya* case, and does not add anything beyond the *In re Nomiya* case.

Accordingly, Applicants respectfully submit that a rejection based on "admitted prior art" cannot be based upon the location of the text at issue, but must be based on the content of the text and the application taken as a whole. As to FIGS. 1 and 2, there is no explicit statement in

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1 See specifically *In re Nomiya*, page 611, second column, paragraph beginning with "[w]e have no doubt…"; page 612, first and second columns, with paragraph beginning with "It is necessary to consider…"

the application that these figures are admitted prior art, and in fact they are described as being illustrative of the present invention in the Detailed Description section of the application (see, for example, page 9, lines 15-17). As to pages 1-6 of the application, Applicants respectfully submit that text from page 1, line 26 through page 6, line 3, describes the Applicants' thinking process and investigations that were part of making their invention. Lines 26-30 of page 1 of the Specification introduce a device for lasing at 0.98 μm as an object of investigation by the inventors. The construction and manufacture of this investigated device are subsequently described from page 1, line 31 through page 2, line 23 of the Specification. Then, at page 3, lines 3-8 of the Specification, the Applicants outline the investigations on this device that they undertook, and then describe from page 3, line 9 through to page 6 the "***new*** knowledge" that was obtained from their investigations. Applicants respectfully submit that of the language from page 1, line 26 through page 6, line 3 does not contain content required to form a rejection based on admitted prior art, and that this language and the application as a whole is contrary to such an allegation. Accordingly, Applicants respectfully request that the allegation of admitted prior art be withdrawn.

Applicants are not aware of any case which holds that the entire discussion contained in the "Background of the Invention" or "Discussion of Related Prior Art" portion of an application constitutes an admission. Such a rule is neither workable nor fair, and flies in the face of the reality of how applications are drafted. Such a rule would cause Applicants to *not* discuss the background of their inventions for fear that everything they say will be alleged to be admitted prior art. While it appears that the courts have not fully addressed the requirements for establishing when a discussion in an application constitutes an admission, Applicants respectfully submit that one such requirement must be some statement by the Applicant which supports a finding that there has been a chargeable and irrevocable admission. There has been no such statement here. In the case of *In re Nomiya*, supra, the Applicant *did not contest* the allegations of admitted prior art made by the Board. Instead, the Applicant argued that the subject matter at issue was only prior art in Japan, and that it should not be considered as prior art in the United States because the subject matter at issue did not fall within the bounds of 35 U.S.C. §102.

Response to the Rejection of Claims 1-8 under 35 U.S.C. 103.

Since this rejection of the claims under 35 U.S.C. 103 is based on the allegation of admitted prior art, and since Applicants have shown that the allegation does not have a proper basis, Applicants respectfully submit that this rejection of Claims 1–8 lacks a sufficient basis. Accordingly, Applicants respectfully submit that the rejection be withdrawn.

Response to the Objection to the Drawings.

Since the objection to FIGS. 1–5 is based on the allegation of admitted prior art, and since Applicants have shown that the allegation does not have a proper basis, Applicants respectfully submit that this objection lacks a sufficient basis. Accordingly, Applicants respectfully submit that the objection be withdrawn.

Response to the Objection to the Specification.

Since the objection to Specification is based on the allegation of admitted prior art, and since Applicants have shown that the allegation does not have a proper basis, Applicants respectfully submit that this objection lacks a sufficient basis. Accordingly, Applicants respectfully submit that the objection be withdrawn.

Nonetheless, Applicants are willing to amend the Specification in order to reduce the number of sections in which FIGS. 1-5 are described. With this amendment, Applicants have moved the text at page 1, line 26 through page 6, line 3 forward to the Detailed Description Section to replace the two paragraphs at page 9, lines 15-23. In turn, Lines 22-23 of page 9 have been moved forward to page 12, between lines 6 and 7 thereof.

To provide smooth transitions to the paragraphs moved from pages 1-6, the first sentence of the first paragraph has been amended as indicated in the mark-up version provided at the end of this Amendment, and a bridge paragraph has been added to end of the relocated paragraphs. The bridge paragraph reads as follows:

> "From these investigations, the inventors discovered that the linearity of the current-optical output characteristic curve can be secured by adjusting the cavity length

(L) to a value not smaller than 1200 μm. Preferably, the device has a transverse light confinement structure with the transverse refractive index difference of about 1 x 10^{-2} for oscillation modes, the reflectance of the low-reflection film on the one end face is 5% or less, and the active layer is formed of one or two quantum well structures."

The bridge paragraph is a combination of sentences from the Summary of the invention section, page 7, line 32 through page 8, line 3, and page 8, lines 12-19.

As a replacement of the text at pages 1-6, Applicants have provided a substitute paragraph:

"In the opinion of the inventors, one basic requirement for a pumping laser diode is that its optical output power increase in a substantially smooth manner at high optical output powers as the driving current to the laser diode is increased. However, when the above-described laser diodes are attempted for use in pumping laser applications, the inventors have often found that these laser diodes do not have smooth curves at the high power levels required by pumping applications. The lack of smoothness is evidenced by the presence of kinks in the graph of optical output power versus driving current for the laser diodes."

This replacement paragraph summarizes the needs and problems that then inventors have found from their experience and investigations. This summarization is based on the disclosure in the Summary of the Invention section.

Applicants respectfully submit that no new matter has been entered by these amendments to the Specification.

Voluntary Amendments to Claim 1.

The amendments to Claim 1 are voluntary, and are not made in response to the rejection under 35 U.S.C. §103.

In the first line of Claim 1, the term "semiconductor laser device" has been changed to "semiconductor pumping laser device." Support for this amendment is found on page 1, lines 5-11 which indicates that the preset invention is directed to pumping laser light, and page 6, line 14, which indicates pumping light sources.

The last line of Claim 1 ("the cavity length of the device being 1,200 μm or more") has been moved to the beginning of the claim body, and has been given an explicit antecedent basis by reciting the resonator cavity. This beginning paragraph also provides an explicit antecedent basis for the first and second end faces which are recited near the end of the claim body. This beginning paragraph has also been amended to indicate that the width of the resonator cavity can only support a single *transverse* mode. (Please note that the *transverse* mode is different from the *longitudinal* mode.) Support for this amendment is found in FIG. 5 where the far-field pattern shows a single transverse mode, and on page 5, lines 16-27, wherein "unit-modal transverse oscillation" is indicated at line 25. "Unit-modal transverse oscillation" is the same as "single transverse mode oscillation." It is known in the laser art that the width of a resonator cavity portion determines the number of transverse modes that can be supported by that cavity portion.

The next paragraph of Claim 1 has been amended to indicate that the laminated structure which comprises at least one quantum well structure is formed on a substrate, and that at least a portion of the laminated structure is disposed in the cavity portion. Among other places, support for these amendments appear on page 11, lines 22-31, where it is disclosed that two cladding layers and an active layer 3 having two quantum wells are formed on a substrate, with the upper part of the laminated structure being formed into a mesa structure. Since the mesa structure defines the region through which current is injected to the quantum wells, the cavity resonator lies below the mesa structure, and thus at least a portion of the laminated structure is disposed in the cavity portion.

Finally, the last two paragraphs have been amended to provide numerical ranges for the reflectances of the low-reflectance film and the high-reflectance film. Support for this amendment is found on page 11, lines 16-19.

Accordingly, Applicants respectfully submit that no new matter has been entered by these amendments to Claim 1.

Support for New Claims 9-28.

New Claim **9** is supported by the Disclosure at page 1, lines 5-11 (which indicates that

the present invention is directed to pumping laser light sources at 0.98 um), and at page 6, lines 23-26 (which indicates oscillation in a wavelength band of 0.98 um).

New Claims **10**, **18**, and **23** are each supported by page 12, lines 26-27 (which discloses the 350 mA current level), further by page 12, lines 17-21 of the original application which discloses the kink state as being a 15% variation (*i.e.*, kink) of the external differential quantum efficiency, and further by FIG. 4. As is known in the laser art, the slope of the line in FIG. 4 is the external differential quantum efficiency. Except for the kinked section, the slope of the line shown in FIG. 4 is substantially constant, with its value being equal to the initial value present when the injected current just exceeds the threshold current.

New Claims **11**, **19**, and **24** are each supported by page 12, lines 28-29 (which discloses the 700 mA current level), further by page 12, lines 17-21 of the original application which discloses the kink state as being a 15% variation (*i.e.*, kink) of the external differential quantum efficiency, and further by FIG. 4. As is known in the laser art, the slope of the line in FIG. 4 is the external differential quantum efficiency. Except for the kinked section, the slope of the line shown in FIG. 4 is substantially constant, with its value being equal to the initial value present when the injected current just exceeds the threshold current.

New Claim **12** and **16** are each supported by page 11, lines 22-28 (which discloses a GaAs substrate and a laminate structure including at least gallium and arsenic), and by original Claim 4 (which discloses not more than two quantum well structures).

New Claims **13**, **21**, and **26**, are each supported by original Claim 2.

New Claims **14**, **22**, and **28**, are each supported by original Claim 5.

New Claims **15**, **20**, and **25** are each supported by page 10, lines 6-11.

New Claim **17** is supported by the disclosure of GaInNAs material on page 9, lines 22-23.

New Claim **27** is supported by original Claim 4.

Accordingly, Applicants respectfully submit that new Claims 9-28 do not enter new matter.

CONCLUSION

In view of the remarks made above, Applicants respectfully submit that the application is in condition for allowance and action to that end is respectfully solicited. If the Examiner should feel that a telephone interview would be productive in resolving issues in the case, she is invited to telephone the undersigned at the number listed below after 11:00 a.m. PST (2:00 EST).

Respectfully submitted,

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"Version with Markings to Show Changes Made"

Additions are shown by **bold underlining**, deletions are shown with **[bold brackets]**.

In the Claims:

Claim 1 has been amended as follows:

1. **(Once Amended)** A semiconductor **pumping** laser device comprising:

a resonator cavity having a first end face and a second end face, and comprising a cavity portion between the first and second end faces, the cavity portion having a length greater than or equal to 1200 μm and a width that can only support a single transverse mode;

a laminated structure of a semiconductor material including an active layer **[formed of a]** **comprising at least one** quantum well structure**, said laminated structure being formed on a substrate and having at least a portion disposed in said cavity portion**;

a low-reflection film **formed having a reflectance of 5% or less** on one end face of the structure; **and**

a high-reflection film **having a reflectance of 80% or more** formed on the other end face of the structure**[; and**

the cavity length of the device being 1,200 μm or more].

In the Specification:

The replacement paragraphs for page 9, line 15-23 are taken directly from the paragraphs starting at page 1, line 26 through page 6, line 3 of the original Specification, with the following changes and addition of a bridge paragraph at the end:

[For Example, the] **The** following semiconductor laser device that oscillates with a wavelength of 0.98 μm was an object of investigation **by the inventors** as a pumping light source for optical fiber amplifier. This device will now be described with reference to the accompanying drawings. FIG. 1 is a side view showing the semiconductor laser device, and FIG. 2 is a sectional view taken along line II-II of FIG. 1.

The device has a layer structure of a semiconductor material, including a lower clad layer

2 of n-AlGaAs, an active layer 3 of a quantum-well structure made of InGaAs and GaAs, an upper clad layer 4 of p-AlGaAs, and a cap layer 5 of p-GaAs, which are stacked in layers on an n-GaAs substrate 1. A part of the upper clad layer 4 and the cap layer 5 form a mesa structure, and a passivation film 6 of SiN is formed on the lateral of the mesa structure. Further, an upper electrode 7 of Ti/Pt/Au is formed on the cap layer 5 and the passivation film 6, and a lower electrode 8 of AuGe/Ni/Au is formed on the back surface of the substrate 1.

The device A is manufactured in the following manner. The aforesaid layer structure is formed on the n-GaAs substrate by, for example, the MOCVD method, and the upper and lower electrodes are formed on the upper and lower surfaces, respectively, of the layer structure. Thereafter, the resulting structure is cleft with a given cavity length L, a low-reflection film 9 of, e.g., SiN is formed on one end face (front facet) S_1 of the structure, and a high-reflection film 10 of, e.g., SiO_2/Si is formed on the other end face (rear facet) S_2.

In the case of the device A having this mesa structure, it is believed that high optical output can be effectively obtained by increasing the cavity length L. This is because if the cavity length L increases, the influence of heat can be lessened, so that high-optical output can be expected. If the cavity length is too long, however, the differential quantum efficiency of the device A lowers, so that higher current is required for high-optical output operation. Normally, therefore, the cavity length L of the device A with this construction is designed so that the cavity length L is not longer than 1,000 μm.

The inventors hereof examined the current-optical output characteristic for the case where the cavity length L of the device A with the layer structure shown in FIGS. 1 and 2 was adjusted to 800 μm. Thereupon, the characteristic curve of FIG. 3 and the following new knowledge were obtained.

When a driving current (A_1) of about 200 mA was injected, as seen from FIG. 3, a first kink (a_1) was generated in the optical output, and the existing linear relation between the driving current and the optical output disappeared. If the driving current was further increased to a level (A_2) of about 500 mA, a second kink (a_2) was generated in the optical output. Thus, in the case of the device A, the two kinks a_1 and a_2 were generated in the current-optical output characteristic curve as the driving current was increased.

Accordingly, the inventors hereof first closely examined the oscillation spectrum of the device A. The following is a description of the results of the examination.

(1) FIG. 4 shows an oscillation spectrum obtained when the injected current was at about 200 mA.

As seen from this oscillation spectrum, there is a small number of longitudinal modes which oscillate actually in a gain band g. The intensity of a central longitudinal oscillation mode B_0 is 5 dB or more higher than those of side modes B_1 and B_2. As a whole, single longitudinal mode oscillation that is prescribed by the central longitudinal oscillation mode B_0 is dominant.

(2) An oscillation spectrum obtained when the first kink (a_1) was generated indicates that the central longitudinal oscillation mode B_0 jumps to the side mode B_1 at a distance of about 0.4 nm therefrom when the gain band shifts to the longer wavelength side as the temperature of the device rises with the increase of the injected current.

The probability of generation of single longitudinal mode oscillation is related to a spontaneous emission factor (βsp) given by

$$\beta sp = \Gamma \bullet \lambda^4 \bullet K/4\pi^2 \bullet n^3 \bullet V \bullet \delta\lambda, \qquad (1)$$

where Γ is the confinement coefficient of the active layer, λ is an oscillation wavelength, K is a factor reflective of the complexity of the electric field for a transverse mode, n is an equivalent refractive index, V is the volume of the active layer, and $\delta\lambda$ is the half width of the spontaneous emission spectrum. It is believed that the smaller the value βsp, the higher the probability of generation of single longitudinal mode oscillation is.

In the case of the device A, therefore, the oscillation wavelength (λ) is as short as 0.98 μm, so that βsp is lowered in proportion to the fourth power of λ. Accordingly, the device A can be supposed to be able to cause single longitudinal mode oscillation with high probability.

The following problem will be aroused, however, if a module is constructed in a manner such that the device A that undergoes single longitudinal mode oscillation is connected to an optical fiber. A laser beam generated by single longitudinal mode oscillation has its noise properties lowered under the influence of return light from an end portion of the optical fiber. Further, the oscillation of the laser beam is made unstable by the return light. Accordingly, an optical output fetched from the module and monitor current are rendered unstable.

In order to use the device A as a reliable pumping light source for optical fiber amplifier, therefore, it is necessary to solve the above problem that is attributable to single longitudinal mode oscillation.

The result (2) implies the following situation. In consideration of gain differences caused between the longitudinal modes for single longitudinal mode oscillation for the aforesaid reason, the longitudinal mode hopping occur which causes substantial discontinuous fluctuations of the optical output when the gain band shifts to the longer wavelength side in response to temperature rise. When the injected current almost reaches the level A_1, therefore, the current-optical output characteristic loses its linearity, so that the first kink (a_1) is generated.

Then, the inventors hereof observed a far field pattern of the device A and obtained the findings shown in FIG. 5.

In FIG. 5, curve C_1 represents a transverse oscillation mode for the case where the injected current is lower than A_2, and curve C_2 represents a transverse oscillation mode for the case where the injected current is near A_2 (or where the second kink a_2 is generated).

If the injected current increases to A_2, as seen from FIG. 5, unit-modal transverse oscillation modes shift horizontally from the center position of the device A (or undergo beam steering). Thus, the direction of emission of the laser beam changes.

In the case where the module is constructed by connecting the optical fiber to the device A, therefore, the optical output fetched through the optical fiber fluctuates when the injected current reaches a value approximate to A_2. This is supposed to result in the generation of the second kink (a_2) in the current-optical output characteristic curve.

<u>From these investigations, the inventors discovered that the linearity of the current-optical output characteristic curve can be secured by adjusting the cavity length (L) to a value not smaller than 1200 μm. Preferably, the device has a transverse light confinement structure with the transverse refractive index difference of about 1 x 10^{-2} for oscillation modes, the reflectance of the low-reflection film on the one end face is 5% or less, and the active layer is formed of one or two quantum well structures.</u>